ISSN: 2394-1391

Indian Journal of Biology
Volume 4 Number 2, July - December 2017
DOI: http://dx.doi.org/10.21088/ijb.2394.1391.4217.1

Original Article

Statistical Approach to Analyse the Present Ecological Status of Ichthyofauna of River Churni, West Bengal

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Abstract

Fish, one of the most important protein sources for human, is also an important vertebrate member of aquatic medium. Fisheries sector also contributes a major amount of the total economy of India. Fish diversity, an important indicator of the ecological status of any aquatic ecosystem (both lotic and lentic), is estimated by the use of different statistical approaches. Determination of relative abundance, habitat orientation score and trophic level score of the available fish species and also use of biotic index in any aquatic system depict the ichthyofaunal status with a clear indication of the vulnerability of the ecosystem. Owing to this, a study was conducted from January, 2012 to December, 2014 on River Churni, a major source of the surface water of Nadia district of West Bengal to measure the present status of species diversity and seasonal variation of assemblage of fish fauna. Data have been collected throughout the total span of investigation from major catchment sites of different parts (i.e., up stream, mid-stream, downstream) of the river. Studies have revealed that a total of 38 species of 7 orders and 17 families of fishes are there in the river. The number of available fish species has been found to be variable according to the season and part of the river. Trophic level score has revealed that omnivore fishes (34.78%) are predominant in upper stretch of the river and are followed by carnivore (30.43%), planktivore (26.08%) and benthic feeder (8.69%). In mid-stream, the trophic level score is found to be oriented in the following manner i.e., PL (33.33%)> OM (30.55%) > CA (22.22) > BE (8.69%). Apart from this, the values of Shannon-Weiner index (2.62-3.49), Simpson's index (0.034-0.077) have indicated the more stable condition in downstream of the river than the upper parts. As, the river has been cited to have degrading ecological condition by many authors, results from this investigation will be helpful for the implementation of conservation ideas of the fish fauna in the river.

Keywords: Fish; River Churni; Ichthyofauna; Statistical Approaches; Biotic Index.

Introduction

India, an important mega diversity country, holds the ninth rank in the world in terms of freshwater diversity (Mittermeier and Mitemeier, 1997) having about 2500 fish species in total (Kar et al., 2003). This huge diversity of fish is also an important source of economy of our country. But, the production from the fisheries has been found to be constrained due to the increasing problem of pollution. According to the estimate by Kar et. al. (2003), 930 species among the 2500 are freshwater dweller and the rest are marine. This report has been found to be quite similar to the report of Talwar and Jhingran (1991). Talwar and Jhingran (1991) have listed 2546 species of fish belonging to 40 orders, 254 families and 969 genera. Fishes can be widely used as one of the suitable indicators of pollution in aquatic ecosystem (Kumar and Mathur, 1991). Abdel-Baki *et al.*, (2011) considered the position of fishes in trophic level as the most important reason behind their selection as bio-indicator.

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Received on 13.12.2017, **Accepted on** 30.12.2017

Ecological degradation of any river is indicated by loss of its diversity. Sharp declination in piscian diversity has been found to be an indicator to disturbances in aquatic ecosystem. According to several authors, River Churni has been cited as a river with the problem of ecological degradation (Panigrahi and Bakshi, 2014; Panigrahi et al., 2015). According to Das and Chakrabarty (2007), 63.6% of fish species appeared to have been eliminated from the polluted Churni River since 1983 in 20 years. They have reported about the presence of 44 species of fishes in both River Churni and River Jalangi in 1983. In 2007, the available amount of fish species has been found 16 in River Churni, as reported by Das and Chakrabarty (2007). Bakta and Bandyopadhyay (2007) has reported that River Churni comprises 48 fish species under 29 genera, 18 families and 8 orders including 8 species of exotic fish under 3 orders, 4 families and 6 genera. A long stretch of the lower part of River Ganga resides as the western boundary of this district. Ghosh (2008) has reported that River Ganga comprises about 156 fish species in its lower stretch. According to Bakta and Bandyopadhyay (2007), eight numbers of exotic or alien species *viz., Oreochromis mossambicus, O. niloticus, Hypophthalmicthys molitrix, H. nobilis, Cyprinus carpio, Ctenopharyngodon idella, Clarias gariepinus, Pangasius sutchi,* have been reported during an extensive survey. According to Das and Chakrabarty (2007), 28 number of fish species *viz.,Labeo bata, Puntius sophore, Amblypahyngodon mola, Mystus aor etc.* have been reported to be eliminated. The recent survey has been done to prepare the recent exact piscian diversity for this river. Statistical approaches have been made to analyse the present status of ecology of the system.

Materials and Methods

Study Area

The fishermen interviews have been conducted in the 3 study areas (or villages or stations) beside River Churni during January, 2012 to Dec, 2014.River Churni, one of the important distributaries of River Mathabhanga, emerges at Krishnaganj, Nadia (West Bengal).Flowing about at 54 kms, it finally pours its content to River Bhagirathi- Hooghly near Mangaldeep, Payradanga ofdistrict Nadia. Three villages mostly inhabited by fishers have been selected for this survey by a standard statistical method. The sites for interview programme have been selected in such a manner that all the three parts *viz.,* up-stream, mid-stream and lower-stream must contain a site. Latitude and longitude of those three sites of the sampling has been listed below (Table 1).

Table 1: Sites for interview programme (Villages) and Positions

Sites	Latitude	Longitude
Mamjoan, Nadia	88°58´N	23°30´E
Gajantala, Nadia	88°53´N	23°15´E
Kayet Para, Nadia	88°56´N	23°19´E

Data Collection Method

Pre-tested interview schedule (Panigrahi and Bakshi, 2014) has been used for the collection of information after conducting a preliminary survey to construct a clear idea about the present available fish fauna. The data related to present status of piscian diversity of the river have been collected directly either from the major catchment sites of the river or from the fishermen families through personal discussions and interviews regarding the available fish and their production. Visiting major catchment sites and river side fish markets have been proved to be useful to gather some knowledge on the fish availability. Fishes have been frequently collected from sampling sites and taken to the laboratory for identification. Photographs of the collected samples have also been taken (using Nikon Coolpix, Model: L810) for identification.

Calculations

Trophic level scores have been measured to categories the fishes into different trophic groups based on their feeding habits (Karr et al., 1986; OPEA, 1987). The "trophic level score" (Wichert and Rapport, 1998; Gauch, 1982) represents the relative frequency of the fish using the particulartrophic level among all the trophic level available in thataquatic system. "Habitat orientation score" (Wichert and Rapport, 1998; Gauch, 1982) represents the relative frequency of the fish using the particular habitat among all the habitats available in that aquatic system (Das and Chakrabarty, 2007).

The Shannon Weiner (H) and Simpson indices (D) are the two most widely used species diversity indices for examining overall community characteristics. The formula is given below:

$$H' = \sum_{i=l}^{S} Pi \ln Pi; Pi = \frac{ni}{N}, D = \sum_{i=1}^{s} \frac{ni(ni \quad 1)}{N(N \quad 1)}$$

N= Total Number of organism, n_i= Number of organism of i^{th} Population, s= total number of species

Result and Discussion

Fish fauna study of the River Churni has revealed that there are huge variations in fish availability according to the different part of the stretch or to the seasons.

The study has explored the fact that upper part or upstream of the river is highly affected by the pollution as only 15 species have been found in Pre Monsoon seasons and only 17 in post monsoon time. 22 number of fish species have been evident in the upstream during the monsoon period. The probable reason behind this situation may be the over flow of the water from river side beels or other water bodies. Mid-Stream of the river has found to possess 22, 33 and 21 species in the Pre monsoon, monsoon and post monsoon time respectively. Presence of 6 exotic species has been listed during the study. The total available 38 species of fishes can be grouped into 7 orders and 17 families. Presence of six number exotic species is an indicator of ecological degradation. A total of 23 species have been found in Up-stream, 36 in Mid-stream and 38 in Down-stream in all seasons.

Among 38 numbers of total available fish species, 9 species have been found to be carnivore whereas; planktivore (13 species), benthic eater (5 species) and omnivorous (11 species) have also been found. Presence of 23.68% of carnivore species depicts about river's degrading situation (Table 2).

Trophic level study and habitat orientation study have been done to measure the ecological condition of different part of the river. Trophic level score has revealed that omnivore fishes (34.78%) are predominant in upper stretch of the river and are

Table 2: Trophic level and Habitate orientation of the available fish fauna during the survey (2012-2014)

Sl. No.	Scientific name	Trophic level nature	Trophic level score (%)			Habitat orientation nature	Habitat orientationscore (%)		
			Up	Mid	Down		Up	Mid	Down
1.	*Catla catla*	PL	26.08	33.33	34.21	P	43.47	47.22	22.22
2.	*Labeo rohita*	PL	26.08	33.33	34.21	P	43.47	47.22	22.22
3.	*Labeo bata*	PL	-	-	34.21	P	-	-	22.22
4.	*Labeo calbasu*	BE	-	13.88	13.15	B	-	22.22	21.05
5.	*Cirrhinus mrigala*	BE	-	13.88	13.15	B	-	22.22	21.05
6.	*Amblypharyngodon mola*	PL	26.08	33.33	34.21	P	43.47	47.22	22.22
7.	*Puntius sarana sarana*	PL	-	33.33	34.21	P	-	47.22	22.22
8.	*Puntius ticto*	PL	-	33.33	34.21	P	-	47.22	22.22
9.	*Chela laubuca*	OM	-	30.55	28.94	P	-	47.22	22.22
10.	*Securicula gora*	PL	26.08	33.33	34.21	P	43.47	47.22	22.22
11	*Cyprinus carpio*	BE	8.69	13.88	13.15	B	21.73	22.22	21.05
12.	*Hypophthalmichthys molitrix*	PL	26.08	33.33	34.21	P	43.47	47.22	22.22
13.	*Aristichthys nobilis*	PL	26.08	33.33	34.21	P	43.47	47.22	22.22
14.	*Ctenopharyngodon idella*	OM	34.78	30.55	28.94	G	34.78	30.55	28.94
15.	*Sperata aor*	OM	34.78	30.55	28.94	G	34.78	30.55	28.94
16.	*Sperata seenghala*	OM	-	30.55	28.94	G	-	30.55	28.94
17.	*Rita rita*	CA	30.43	22.22	23.68	B	21.73	22.22	21.05
18.	*Wallago attu*	CA	-	22.22	23.68	G	-	30.55	28.94
19.	*Ailia coila*	PL	-	33.33	34.21	P	-	47.22	22.22
20.	*Silonia silondia*	OM	-	30.55	28.94	G	-	30.55	28.94
21.	*Eutropiichthys vacha*	CA	30.43	22.22	23.68	P	43.47	47.22	22.22
22.	*Clarias batrachus*	OM	34.78	30.55	28.94	P	43.47	47.22	22.22
23.	*Heteropneustes fossilis*	OM	34.78	30.55	28.94	B	21.73	22.22	21.05
24.	*Awaous grammepomus*	BE	-	13.88	13.15	B	-	22.22	21.05
25.	*Anabas testudineus*	OM	34.78	30.55	28.94	G	34.78	30.55	28.94
26.	*Colisa fasciata*	OM	34.78	30.55	28.94	G	34.78	30.55	28.94
27.	*Channa punctatus*	CA	30.43	22.22	23.68	G	34.78	30.55	28.94
28.	*Channa striata*	CA	30.43	22.22	23.68	G	34.78	30.55	28.94
29.	*Channa gachua*	CA	30.43	22.22	23.68	G	34.78	30.55	28.94
30.	*Oreochromis mossambicus*	OM	34.78	30.55	28.94	P	43.47	47.22	22.22
31.	*Oreochromis niloticus*	OM	34.78	30.55	28.94	P	43.47	47.22	22.22
32.	*Nandus nandus*	CA	30.43	22.22	23.68	G	34.78	30.55	28.94
33.	*Macrognathus pancalus*	CA	30.43	22.22	23.68	B	21.73	22.22	21.05
34.	*Monopterus cuchia*	BE	8.69	13.88	13.15	B	21.73	22.22	21.05
35.	*Nematalosa nasus*	PL	-	33.33	34.21	P	-	47.22	22.22
36.	*Setipinna phasa*	PL	-	33.33	34.21	P	-	47.22	22.22
37.	*Xenentodon cancila*	PL	-	33.33	34.21	P	-	47.22	22.22
38.	*Notopterus notopterus*	CA	-	-	23.68	P	-	-	22.22

** PL- Planktivore, BE- Benthic Eater, OM- Omnivore, CA- Carnivore, P- Pelagic, G- Generalist, B- Benthic

followed by carnivore (30.43%), planktivore (26.08%) and benthic feeder (8.69%). In mid-stream, the trophic level score is found to be oriented in the following manner i.e., PL (33.33%)> OM (30.55%) > CA (22.22) > BE (8.69%). Study of average trophic level score confirms that it is higher in the up-sream than mid and lower stream of the river (Table 2). According to Rapport (1995), this situation states that up-stream is much more affected by pollution than the other parts. According to Wichert and Rapport (1998), trophic level study is an important way to evaluate the level of degradation of any ecosystem. They confirmed that omnivore fishes are abundant in disturbed ecosystem as the fishes can consume a wide variety of food sources in changing environment. On the contrary, other trophic levels, in order of sensitivity to degradation, beginning with the least sensitive planktivores followed by pelagic insectivores, benthic insectivores (e.g., benthic feeders) general insectivores or piscivores and finally carnivores at the topmost part of the trophic structure (Karr and Dudley, 1981).

Habitat orientation score has also been measured for each part of the river. But according to Das and Chakrabarty (2007), the habitat orientation score can be used as a useful indicator of ecosystem stress as Wichert and Rapport (1998) also established a similar finding in case of lotic system. The study reveals that most of the fishes in all the three parts of the river are pelagic in nature. Second position is occupied by the generalists or column feeder fishes. Benthic dwellers are least in number in all the three parts. Moderately high diversity of fish species in the downstream of the river represents a variety of appropriate habitat and food types to sustenance many different species, which reflects the similar finding with a report by Washington (1984).

Table 3: Seasonal variation of the values of different Biodiversity indices

Parameters	Up- stream			Mid-stream			Down-stream		
	prM	M	PoM	PrM	M	PoM	Prm	M	PoM
species diversity	0.59	0.77	0.63	0.72	0.87	0.72	0.94	0.92	0.89
shannaon-weiner index	2.62	2.97	2.67	2.97	3.33	2.98	0.28	3.49	3.18
simpsons index	0.077	0.056	0.067	0.056	0.041	0.053	0.041	0.034	0.045

The study has revealed that most of the fish species (33 species) can be included in "Least concern" category according to IUCN Red list. Only one species, *Cyprinus carpio*, has been found to be categoried as "Vulnerable" in India though it is an exotic species (IUCN, 2007, 2008, 2009).

The Shannon Weiner and Simpson indices are the two most widely used species diversity indices for examining overall community characteristics. Both are derived from a function used in the field of information (mainly insurance companies) and have been adapted by ecologists to describe the average degree of uncertainty of predicting the species of an individual picked at random from the community.

Here, values of Shannon Weiner index (Pre Monsoon, Monsoon and Post Monsoon) are higher in the lower stretch depicting the moderately good ecological condition than upper stretch of the river. Simpson Index values show higher diversity in lower stretch than the up and mid-stream.

Thus, it can be concluded from the above discussion that ecological condition of the upper stream of the river is much more disturbed than the middle and lower stretch. No endemic species has been reported in the fish list. Only extensive pollution control strategies and introduction of fresh fish seed can only change the present scenario.

Acknowledgement

We are thankful to the fishermen and fish retailers associated with the river for their support and kind helps during the survey based research.

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